WE CLAIM:

1. An electronic system for selectively detecting and identifying a plurality of chemical species, comprising an array of nanostructure sensing devices, each nanostructure sensing device comprising at least one nanostructure and having a selectivity for sensing the chemical species, wherein the selectivity of the at least one nanostructure sensing device differs from the selectivity of at least one other nanostructure sensing device.

2. The electronic system of Claim 1, further comprising, in each nanostructure sensing device, at least two contact electrodes, the at least two contact electrodes electrically connected by the at least one nanostructure.

3. The electronic system of Claim 2, wherein the at least two contact electrodes comprise a material selected from the group consisting of aluminum, copper, titanium and tungsten.

4. The electronic system of Claim 2, further comprising a protective coating on the at least two contact electrodes.

5. The electronic system of Claim 4 wherein the protective coating is selected from the group consisting of silicon oxides, metal oxides, polymer films, and nonvolatile organics.

6. The electronic system of Claim 2, further comprising a gate electrode in at least a portion of the nanostructure sensing devices in the array of nanostructure sensing devices.

7. The electronic system of Claim 2, further comprising a counter electrode, electrically isolated from the contact electrodes, in at least a portion of the nanostructure sensing devices in the array of nanostructure sensing devices.

8. The electronic system of Claim 7, further comprising a pseudo-reference electrode, electrically isolated from the contact electrodes, in at least a portion of the nanostructure sensing devices.

9. The electronic system of Claim 1, wherein the nanostructure sensing devices comprise at least one nanostructure selected from the group consisting of single-walled nanotubes, multi-walled nanotubes, nanofibers, nanowires, nanocoils, nanospheres, nanocages, nanococoons, nanohorns, nanoropes, nanotori, nanorods, nanoplatelets, and other extended molecules such as polymers, dendrimers, organometallics, fullerene-like molecules, and combinations thereof.

10. The electronic system of Claim 1, wherein the nanostructure sensing devices comprise at least one nanostructure comprising an approximately linear form.

11. The electronic system of Claim 1, wherein the nanostructure sensing devices comprising at least one nanostructure comprises elements selected from the group consisting of boron, carbon, combinations thereof, and combinations with nitrogen.

12. The electronic system of Claim 1, further comprising at least two nanostructure sensing devices having the same selectivity for sensing, wherein at least one of the at least two nanostructure sensing devices is impermeably shielded from at least the plurality of chemical species, and at least one of the at least two nanostructure sensing devices is at least partially exposed to at least the plurality of chemical species.

13. A method of fabricating an electronic system for selectively detecting and identifying a predetermined number of chemical species, comprising the steps of:

(a) providing an array of nanostructure sensing devices, each nanostructure sensing device comprising at least one nanostructure and at least two contact electrodes, wherein the at least one nanostructure provides electrical coupling between the at least two contact electrodes; and

(b) modifying selectivity for sensing of the nanostructures within at least a portion of the array of nanostructure sensing devices, such that at least one nanostructure sensing device produces a measurably changed signal when exposed to the chemical species.

14. The method of Claim 13, further comprising performing step (b) repeatedly on nanostructures within different portions of the array of nanostructure sensing devices using different modifications until there is a variety of selectivity for sensing within the array of nanostructure sensing devices such that each of the predetermined number of chemical species produces a measurably changed signal from the array.

15. The method of Claim 13, wherein modifying comprises using a reactant.

16. The method of Claim 15, wherein modifying further comprises supplying energy to the reactant.

17. The method of Claim 16, wherein the energy is selected from the group consisting of ultraviolet radiation, thermal energy, and electrical energy.

18. The method of Claim 15, wherein the reactant comprises a gas.

19. The method of Claim 15, wherein the reactant comprises an electrochemical solution.

20. The method of Claim 13, wherein the measurably changed signal is selected from the group consisting of electrical signals, optical signals, mechanical signals and thermal signals.

21. The method of Claim 13, further comprising providing at least one gate electrode in each nanostructure sensing device in at least a portion of the array of nanostructure sensing devices.

22. The method of Claim 13, further comprising modifying at least two nanostructure sensing devices to have the same selectivity for sensing, providing shielding impermeable to at least the plurality of chemical species to at least one of the at least two nanostructure sensing devices and allowing at least one of the at least two nanostructure sensing devices to be at least partially exposed to at least the plurality of chemical species.

23. A method of making a sensor array for selectively detecting and identifying a predetermined number of chemical species, comprising the steps of:

(a) providing an array of nanostructure sensing devices, each nanostructure sensing device comprising at least one nanostructure and at least two contact electrodes, wherein the at least one nanostructure provides electrical coupling between the at least two contact electrodes;

(b) providing a plurality of chemical jets wherein at least a portion of the plurality of chemical jets contains a reactant that can modify the selectivity for sensing of the nanostructures;

(c) addressing with at least the portion of the plurality of chemical jets at least the portion of the array of nanostructure sensing devices; and

(d) dispensing drops of the reactant from at least the portion of the plurality of chemical jets to at least the portion of the nanostructure sensing devices in the array of nanostructure sensing devices;

24. The method of Claim 23, further comprising performing (a) through (d) repeatedly, using a different portion of the plurality of chemical jets and a different reactant each time, until there is a variety of selectivity for sensing within the array of nanostructure sensing

devices such that each of the predetermined number of chemical species produces a measurably changed signal from the array.

25. The method of Claim 23, further comprising supplying energy to the reactant.

26. The method of Claim 25, wherein the energy is selected from the group consisting of ultraviolet radiation, thermal energy, and electrical energy.

27. The method of Claim 23, further comprising applying a characteristic voltage across the at least two contact electrodes in each of the nanostructure sensing devices in at least the portion of nanostructure sensing devices after step (d), the characteristic voltage causing initially a current flow through the nanostructures, and continuing to apply the characteristic voltage until the current flow decreases sharply, thereby introducing point defects into the nanostructures in a self-limiting reaction.

28. The method of Claim 27, wherein the point defects have selectivity for sensing chemical species.

29. The method of Claim 27, further comprising dispensing drops of a different reactant to at least the portion of the nanostructure sensing devices in the array of nanostructure sensing devices to promote attachments of molecules to the point defects on the nanostructures.

30. The method of Claim 29, wherein the molecules have selectivity for sensing chemical species.

31. The method of Claim 29, further comprising dispensing, in series, drops of a plurality of reactants to at least the portion of the nanostructure sensing devices in the array of nanostructure sensing devices to promote attachments of a series of molecules, thus forming structures extending from the point defects on the nanostructures.

32. The method of Claim 31, wherein the structures have selectivity for sensing chemical species.

33. The method of Claim 23, wherein the reactant is an electrochemical solution and further comprising:

(e) providing a plurality of counter electrodes, such that there is at least one counter electrode in contact with each drop of the electrochemical solution;

(f) applying a first voltage to the contact electrodes in at least the portion of the array of nanostructure sensing devices; and

(g) applying a second voltage, different from the first voltage to the plurality of counter electrodes in at least the portion of the array of nanostructure sensing devices while the first voltage is applied, thus effecting an electrochemical reaction between the electrochemical solution and the nanostructures within at least the portion of the array of nanostructure sensing devices.

34. The method of Claim 33, wherein providing a plurality of counter electrodes comprises providing a counter electrode, electrically isolated from the contact electrodes in at least the portion of nanostructure sensing devices.

35. The method of Claim 33, further comprising before step (c), providing in each nanostructure sensing device in at least the portion of the array of nanostructure sensing devices a pseudo-reference electrode.

36. The method of Claim 33, wherein providing a plurality of counter electrodes in step (e) comprises providing counter electrodes in at least a portion of the plurality of chemical jets and performing both steps (f) and (g) while the chemical jet is dispensing the drop of electrochemical solution.

37. The method of Claim 33, further comprising, in step (b), providing pseudo-reference electrodes in the chemical jets and performing both steps (f) and (g) while the chemical jet is dispensing the drop of electrochemical solution.

38. The method of Claim 33, further comprising performing steps (a) through (g) repeatedly, using a different electrochemical solution each time, until there is a variety of selectivity for sensing within the array of nanostructure sensing devices such that each of the predetermined number of chemical species produces a measurable signal from the array.

39. A method of making a system for selectively detecting and identifying a predetermined number of chemical species, comprising the steps of:

(a) providing an array of nanostructure sensing devices, each nanostructure sensing device comprising at least one nanostructure and at least two contact electrodes, wherein the at least one nanostructure provides electrical coupling between the at least two contact electrodes;

(b) providing at least one counter electrode;

(c) submerging at least the portion of the nanostructure sensing devices in an electrochemical solution;

(d) applying a first voltage to the contact electrodes in at least the portion of nanostructure sensing devices;

(e) applying a second voltage, different from the first voltage, to the at least one counter electrode, thus effecting an electrochemical reaction between the electrochemical solution and the at least one nanostructure in each nanostructure sensing device; and

(f) rinsing the electrochemical solution from at least the portion of the array of nanostructure sensing devices after applying the second voltage.

40. The method of Claim 39, further comprising performing at least steps (a) through (e) repeatedly using different electrochemical solutions and applying different first voltages and second voltages until there is a variety of selectivity for sensing within the array of nanostructure sensing devices such that each of the predetermined number of chemical species produces a measurable signal from the array.

41. The method of Claim 39, wherein providing the at least one counter electrode comprises providing a counter electrode in each nanostructure sensing device in at least a portion of the nanostructure sensing devices in the array.

42. The method of Claim 39, wherein providing the at least one counter electrode comprises providing at least one counter electrode in the electrochemical solution.

43. The method of Claim 39, further comprising, before step (c), providing a pseudo-electrode in each nanostructure sensing device in at least the portion of the array of nanostructure sensing devices.

44. The method of Claim 39, further comprising, before step (d), providing a pseudo-electrode in the electrochemical solution.

45. The method of Claim 39, further comprising supplying energy to the reactant.

46. The method of Claim 45, wherein the energy is selected from the group consisting of ultraviolet radiation, thermal energy, and electrical energy.

47. A method of fabricating an electronic system for selectively detecting and identifying a predetermined number of chemical species, comprising the steps of:

(a) providing an array of nanostructure sensing devices, each nanostructure sensing device comprising at least one nanostructure and at least two contact electrodes, wherein the at least one nanostructure provides electrical coupling between the at least two contact electrodes;

(b) submerging at least a portion of nanostructure sensing devices in the array of nanostructure sensing devices in a reactant;

(c) applying a characteristic voltage across the at least two contact electrodes in each of the nanostructure sensing devices in at least the portion of nanostructure sensing devices after step (b), the characteristic voltage causing a current flow through the nanostructures, and continuing to apply the characteristic voltage until the current flow decreases sharply, thereby introducing point defects into the nanostructures in a self-limiting reaction; and

(d) rinsing the reactant from at least the portion of the array of nanostructure sensing devices after the self-limiting reaction ends.

48. The method of Claim 47, further comprising supplying additional energy to the reactant.

49. The method of Claim 48, wherein the additional energy is selected from the group consisting of ultraviolet radiation, thermal energy, and electrical energy.

50. The method of Claim 47, wherein the point defects have selectivity for sensing chemical species.

51. The method of Claim 47, further comprising applying a different reactant to at least the portion of the nanostructure sensing devices in the array of nanostructure sensing devices to promote attachment of molecules to the point defects on the nanostructures.

52. The method of Claim 51, wherein the molecules have selectivity for sensing chemical species.

53. The method of Claim 47, further comprising applying a series of different reactants to at least the portion of the nanostructure sensing devices in the array of nanostructure sensing devices to promote reactions wherein a plurality of molecules attach and form structures extending from the point defects on the nanostructures.

54. The method of Claim 53, wherein the structures have selectivity for sensing chemical species.

55. The method of Claim 47, further comprising performing at least steps (a) – (c) repeatedly using different reactants and applying different voltages until there is a variety of selectivity for sensing within the array of nanostructure sensing devices such that each of the predetermined number of chemical species produces a measurable signal from the array.

56. A method for detecting a plurality of chemical species in a surrounding environment, comprising:

measuring first signals from nanostructure sensing devices in an array of nanostructure sensing devices before exposing the array to a surrounding environment, wherein the nanostructure sensing devices have selectivity for sensing chemical species, the selectivity of the at least one nanostructure sensing device differing from the selectivity of at least one other nanostructure sensing device in the array;

measuring second signals from nanostructure sensing devices in an array of nanostructure sensing devices after exposing the array to the surrounding environment, wherein a significant change between the first signal and the second signal for a particular nanostructure sensing device indicates detection of a chemical species;

making correlations between known signal changes between first signals and second signals, which occur when known chemical species are detected and observed changes between the first signals and the second signals; and

interpreting the correlations to identify chemical species in the surrounding environment.

57. The method of Claim 56, wherein the signals are selected from the group consisting of electrical signals, optical signals, mechanical signals, and thermal signals.

58. The method of Claim 56, further comprising applying and maintaining a first gate voltage to a gate electrode associated with each nanostructure sensing device in at least a first portion of the array of nanostructure sensing devices before measuring the first signals from at least the first portion of the array and continuing to maintain the first gate voltage throughout measuring the second signals from at least the first portion of the array.

59. The method of Claim 58, further comprising applying and maintaining a second gate voltage, different from the first gate voltage, to a gate electrode associated with each nanostructure sensing device in at least a second portion of the array of nanostructure sensing devices before measuring the first signals from at least the second portion of the array and continuing to maintain the second gate voltage throughout measuring the second signals from at least the second portion of the array.

60. The method of Claim 56, further comprising applying a series of gate voltages to a gate electrode associated with each nanostructure sensing device in at least a portion of the array of nanostructure sensing devices and measuring the first signals and the second signals from at least the portion of the array of nanostructure sensing devices at each gate voltage.

61. A method for detecting a plurality of chemical species in an environment of interest, comprising:

providing an array of sets of nanostructure sensing devices, each set comprising at least two nanostructure sensing devices, such that the at least two nanostructure sensing devices have a same selectivity for sensing;

providing shielding impermeable to at least the plurality of chemical species to at least one of the at least two nanostructure sensing devices in each set and allowing at least one of the at least two nanostructure sensing devices in each set to be at least partially exposed to at least the plurality of chemical species;

measuring and comparing signals from the at least two nanostructure sensing devices in each set after positioning the array in the environment of interest;

making correlations between known signal differences for shielded and at least partially exposed nanostructure sensing devices in a set when known chemical species are detected and observed differences in signals for shielded nanostructure sensing devices and at least partially exposed nanostructure sensing devices in each set; and

interpreting the correlations to identify chemical species in the environment of interest.

62. The method of Claim 61, wherein the signals are selected from the group consisting of electrical signals, optical signals, mechanical signals, and thermal signals.

63. The method of Claim 61, further comprising applying a first gate voltage to gate electrodes associated with each of the at least two nanostructure sensing devices in each set in at least a first portion of the array of sets before and throughout measuring and comparing signals from the at least two nanostructure sensing devices in each set.

64. The method of Claim 63, further comprising applying a second gate voltage, different from the first gate voltage, to gate electrodes associated with each of the at least two nanostructure sensing devices in each set in at least a second portion of the array of sets before and throughout measuring and comparing the signals from the at least two nanostructure sensing devices in each set.

65. The method of Claim 61, further comprising applying a series of gate voltages to gate electrodes associated with each of the at least two nanostructure sensing devices in each set in at least a portion of the array of sets and measuring and comparing the signals from the at least two nanostructure sensing devices in each set at each gate voltage.